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WHERE THE WORLD TURNS FOR POWER

NUVERA, CATERPILLAR, WIILIAMS BIO- ENERGY

PEM Ethanol Fuel Cell -

Utility Interactive System

Presentation to

Department of Energy

30 Oct 2001

Washington, DC

- Introduction
- Program Contact Points
- Funding and Budgeting
- Program Plan
- Technical Concept
- Q&A and Discussions

PROGRAM PARTNERSHIP

NUVERA

- PEM Fuel Cell and Reformer
- Fuel Cell Control
- System Testing and Key System Variables Data Acquisition
  - Fuel Processor, Fuel Cell, Byproduct Management
  - Fuel Cell Control, System Control Interface

CATERPILLAR

- Program Management
- System Control
- System Testing and Data Acquisition
  - Inverter, Supporting Electronics
  - Electrical Power System Components

WILLIAMS BIO-ENERGY

- Ethanol Fuel Source
- System Test Facility
- System Test Monitoring
  - Power System Integration
  - Facility Resources

Program Contact Points

Principal Investigator

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Program Manager:

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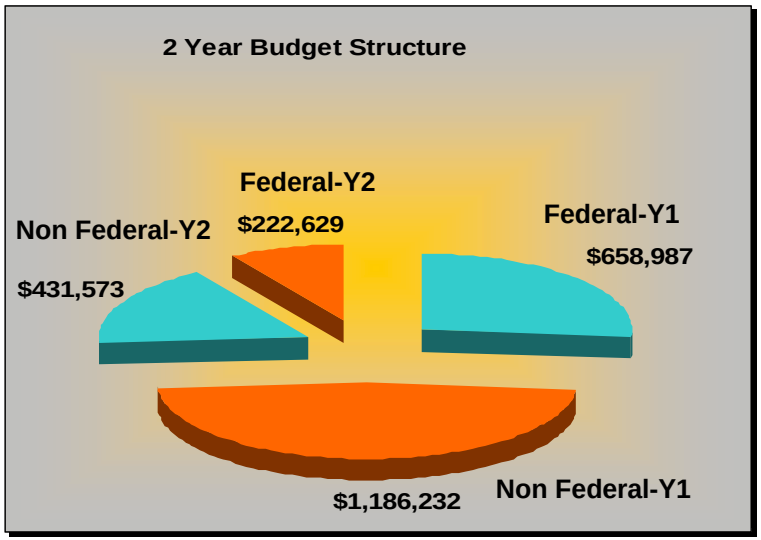
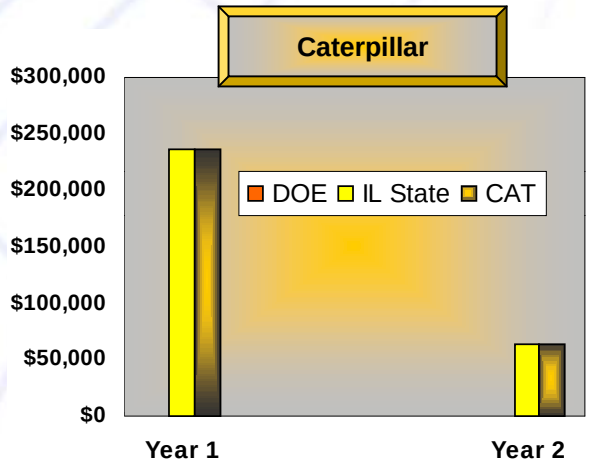
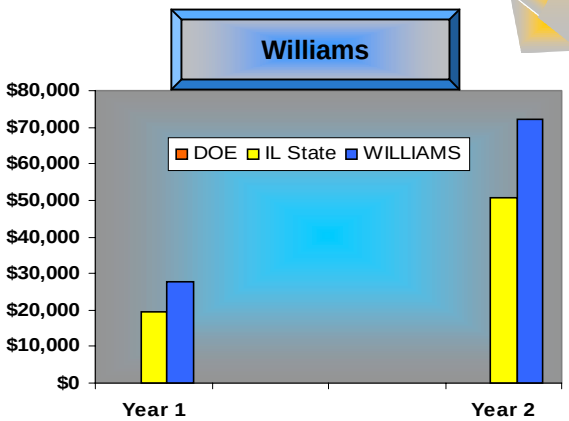
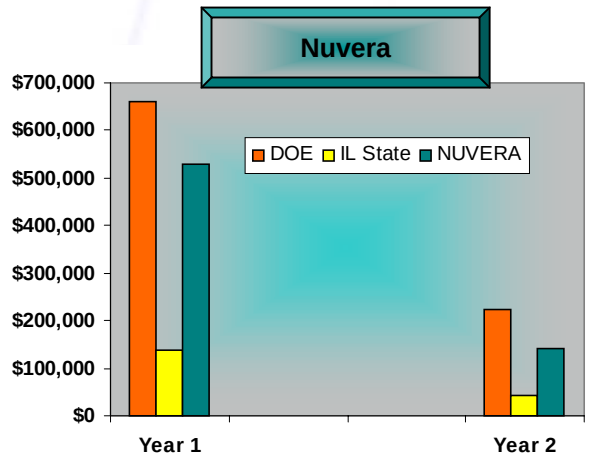
Estimated Funding Structure





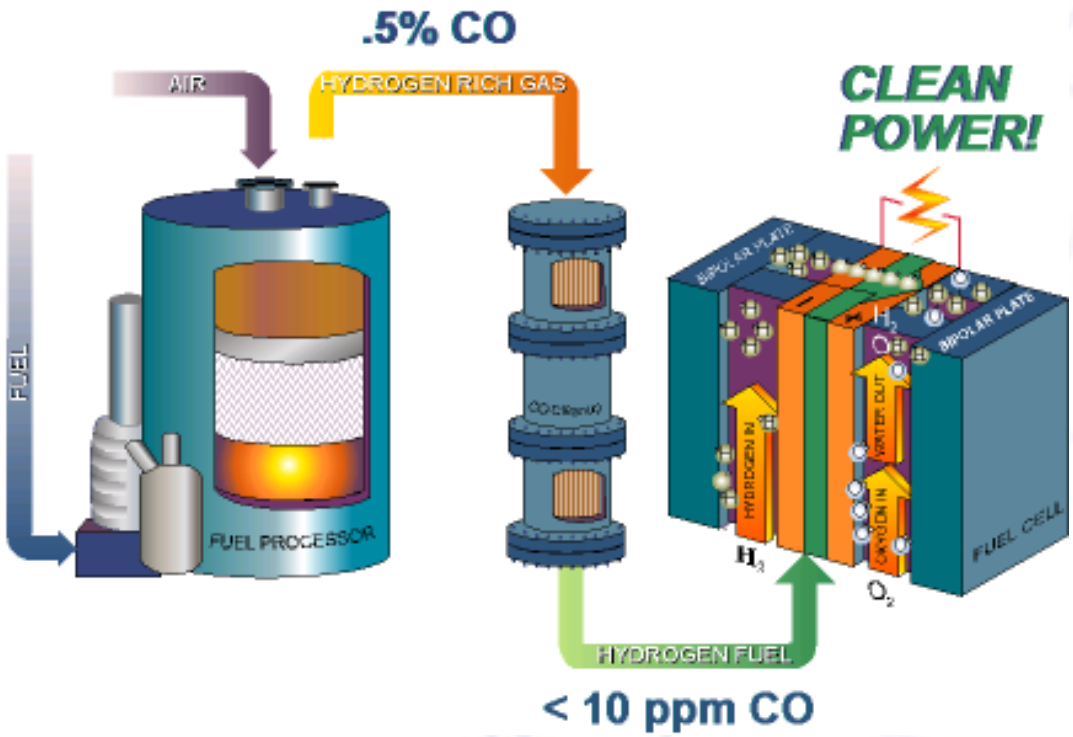




Goals and Objectives

- Demonstrate Performance and Durability
- Remove Technical Uncertainties
- Understand Correlation and Reduce Gaps between Stationary and Transportation Application
- Data Collection to Evaluate Economic Feasibility
- Assess Commercial Viability of Total System

PEM Fuel Cell Power System

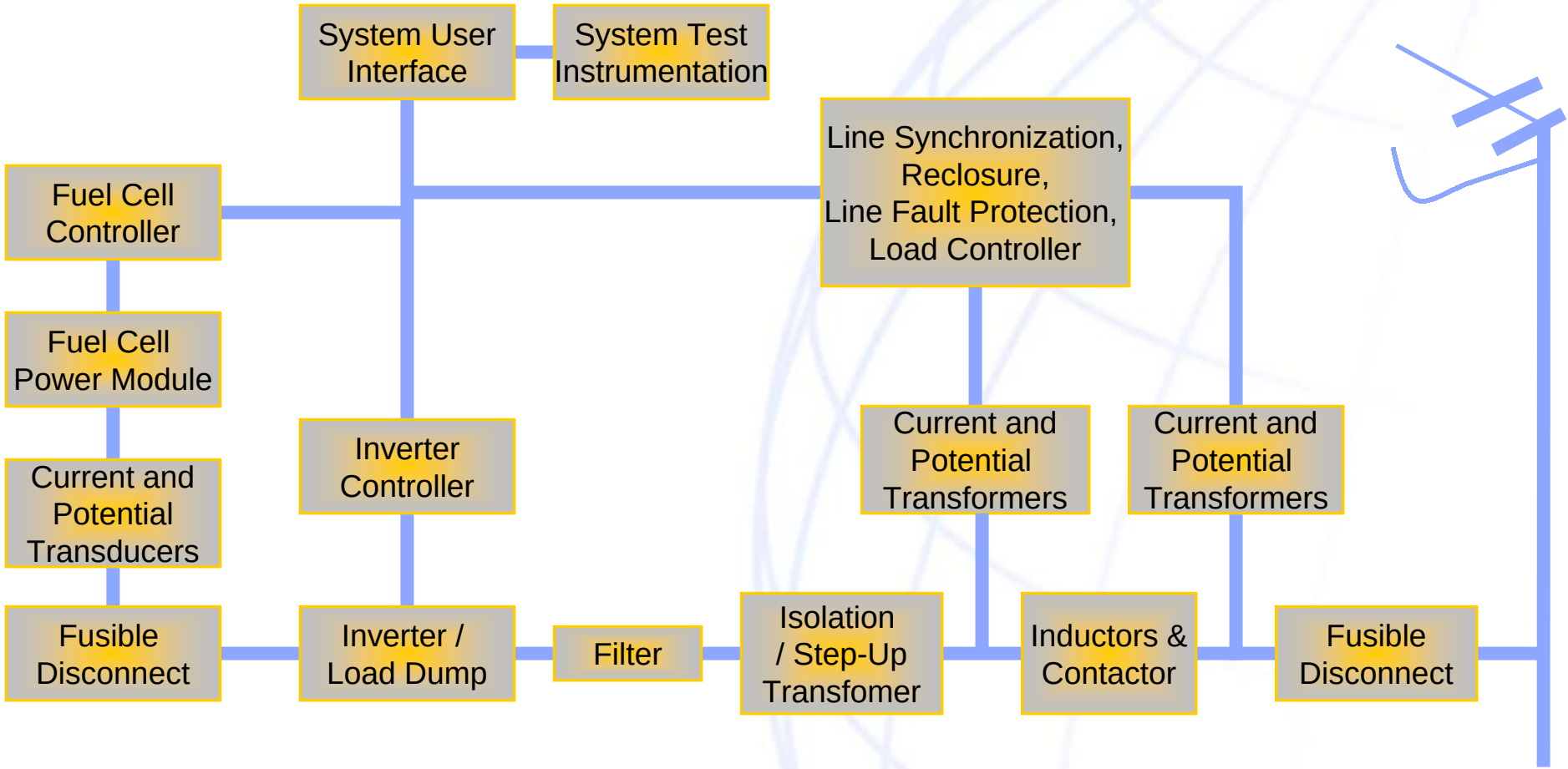


Model "B" Multi-fuel Processor

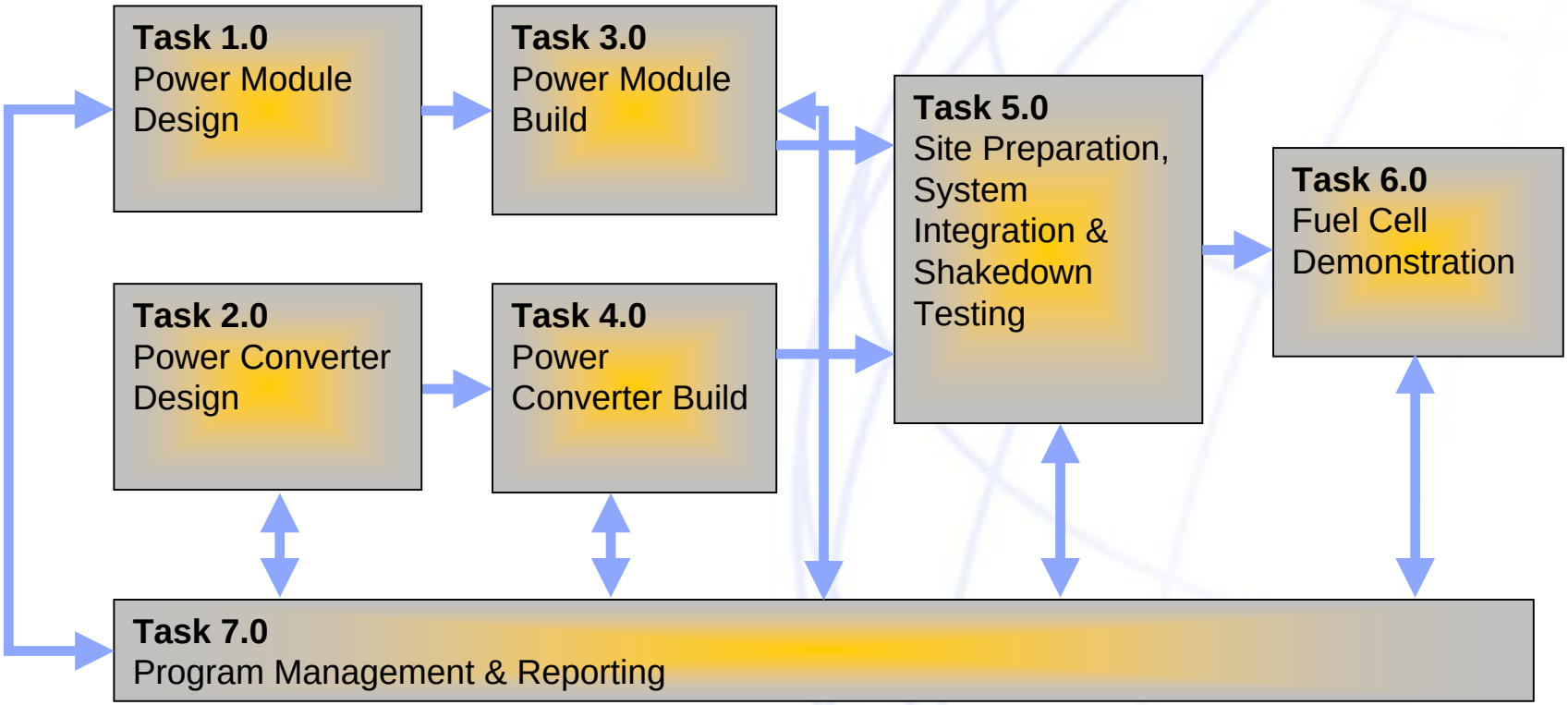
CO Clean-Up Device

Fuel Cell Stack

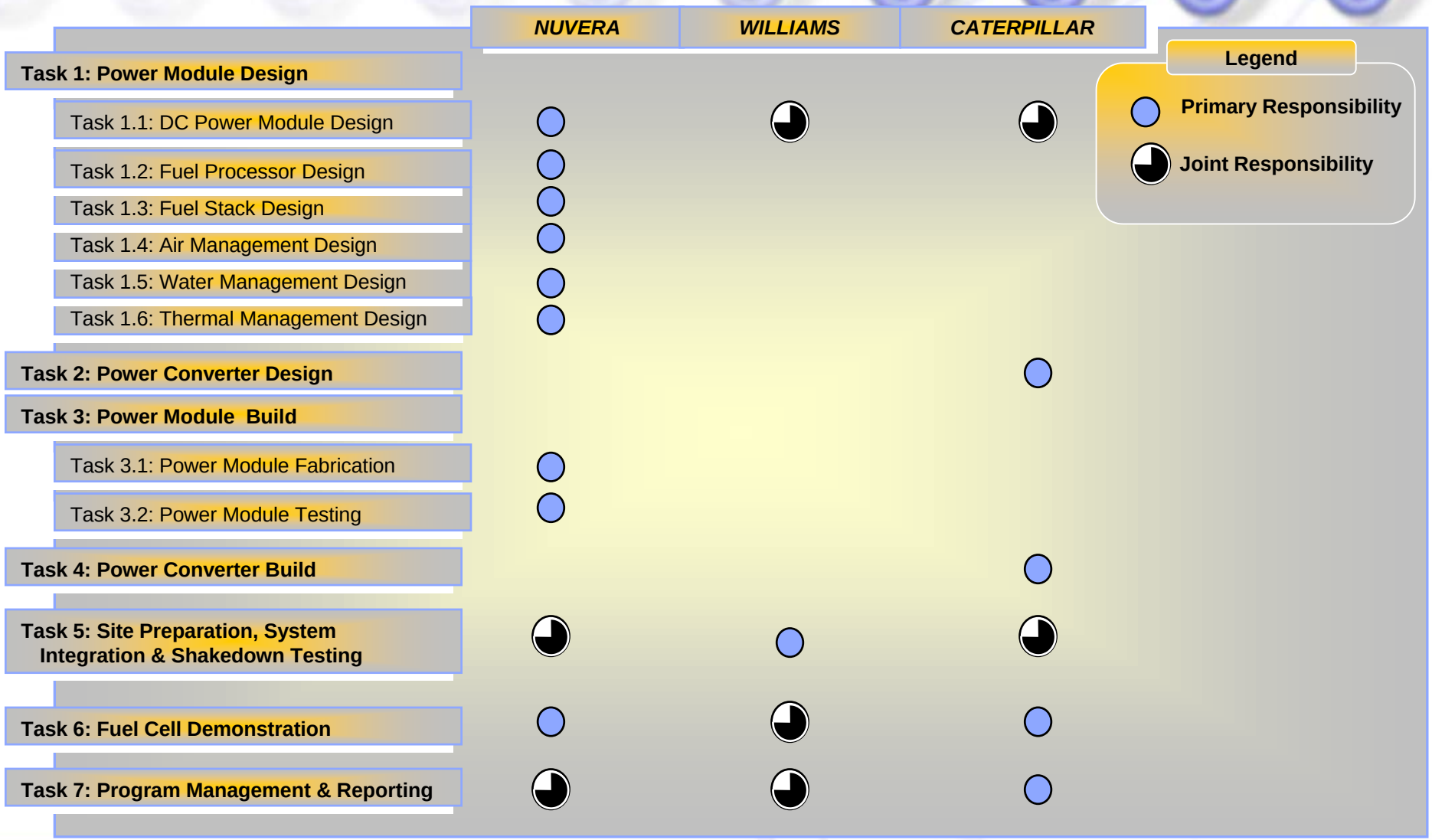
Power System and Control Integration: *Technical Concept*



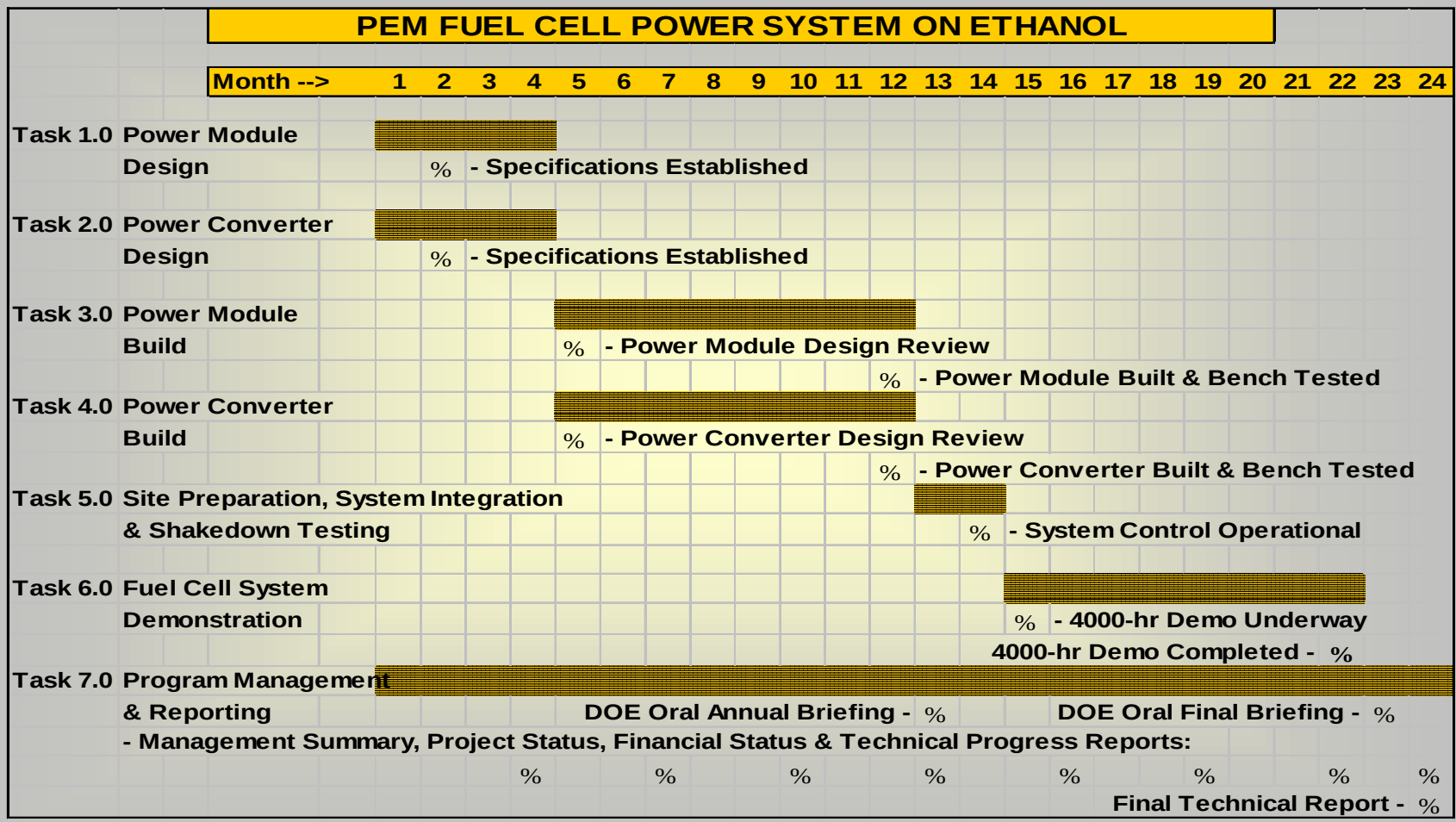
Work Breakdown Structure



TASKS RESPONSIBILITIES



Program Plan



Success and Opportunities

Technical Successes

- 4000 Hr Durability Testing:
  - Fuel Cell & Balance of Plant
  - Continuous 14kWe
  - No Faults/Downtime
- Low Emissions
- Efficiency:
  - System > 25%
  - Inverter > 93%
  - Reformer > 80%
  - Fuel Stack > 50%
- Development of Low Cost Critical Hardware
- Project Documentation, On Time Delivery, and Within Budget

Opportunities

- Development of PEM Fuel Cell Power / Utility Interactive System Integration Competency
- Demonstrate Ability of Partners to Deliver World Class Product
- Influence Direction of Future Enterprises in Fuel Cell / Utility Interactive Systems in Mobile and Stationary Applications
- Demonstrate System Feasibility in Cogeneration Applications, Hybrid, and Other Fuel Applications
- Minimize/Remove Technical Uncertainties and Enhance Learning Curve